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CURRICULUM AND TEACHING OF MATHEMATICS IN THE HIGHER SECONDARY SCHOOLS.

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This curriculum project in general mathematics was planned with two specific objectives--(1) to study the existing curricula, textbooks, and teaching methods in mathematics in higher secondary schools of various states, and (2) to develop a new curriculum in mathematics in light of the objectives of teaching the subject and to try out the experimental curriculum by adopting suitable techniques of teaching and learning. Given is a brief account, in two sections, of how the project was conducted through various stages. Section I deals with the study of the existing syllabuses, textbooks, and teaching methods in mathematics in higher secondary schools. Section II deals with the development of the new curriculum as it involves (1) formulation and specifications of objectives, (2) selection and organization of learning materials, (3) developing the learning experiences, and (4) evaluation of the curriculum. (RP)

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NIE-HEW PROJECT NO.009
CURRICULUM AND TEACHING OF MATHEMATICS
IN THE
HIGHER SECONDARY SECHOOLS

(Project Report)

SE 004 978

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CURRICULUM AND TEACHING OF MATHEMATICS
IN THE
HIGHER SECONDARY SCHOOLS

REPORT OF THE PROJECT

MONOGRAM

NIE-HEW - 009
Department of Curriculum and Evaluation
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L.C.

INTRODUCTION

The project was planned with two specific objectives:-

1. To study the existing curricula, textbooks and teaching methods in mathematics in higher secondary schools of various States.
2. To develop a new curriculum in mathematics in light of the objectives of teaching the subject and to try out the experimental curriculum by adopting suitable techniques of teaching and learning.

In the original plan the project was restricted to only six Hindi-speaking States. Certain changes were later made on the suggestions of the Steering Committee. The analysis of syllabuses and textbooks was extended to all the States, and the study of teaching-learning situations, was limited to only four States, viz. Bihar, Gujarat, Mysore and Punjab and the Union Territory of Delhi.

The reasons for selecting the general mathematics course for this study are given in the plan itself. The original plan had suggested that minimum changes be made when the new curriculum is formulated. But during the implementation of the programme, it was felt that certain far-reaching changes were necessary in the treatment and organisation of mathematical content in the proposed curriculum. These changes were to put more emphasis on basic ideas and their relationships and demand the use of set symbolism and language. As a consequence of these changes it was thought rather difficult to carry out the tryout immediately after the content has been selected. It was felt that unless instructional materials are prepared and teachers are oriented to teaching new materials, it would not be possible to give a fair trial to the curriculum. Therefore, it was decided in the 11th meeting of the Steering Committee to give up the tryout of the curriculum at this stage.

Accordingly work on the following sections (under procedure) in the plan was not taken up .

Section G	Development of appropriate evaluation material
Section H	Trying out the new curriculum in selected schools
Section I	Appraisal of the effectiveness of the new curriculum.
Section J	Revision of the new curriculum.

✓ In the following pages a brief account is given of how the project was conducted through various stages. The report has been divided into two sections. Section I deals with the study of the existing syllabuses, textbooks and teaching methods in mathematics in Higher Secondary Schools. Section II deals with the development of the new curriculum.

Since a detailed report for each of the areas covered in Section I and II has been separately prepared, this report gives only the broad and significant steps covered towards the achievement of the objectives laid down in the plan.

SECTION I

(A Study of existing Syllabuses,
Text Books and Teaching - Learning
Practices in Schools).

As envisaged in the plan, one of the objectives of the project was to study the present position of teaching mathematics in higher secondary schools before any curriculum could be developed. In order to achieve this objective the following three studies were suggested:

A. Survey and analysis of the present syllabuses in mathematics.

B. Analysis of the textbooks in mathematics.

C. Study of the teaching and learning procedures.

A. Survey and analysis of the syllabuses

The survey was confined to the current syllabuses that are in vogue in different States for the elementary stage of schooling and for general mathematics at the secondary stage. The main purpose was to obtain a comprehensive view of the present syllabus in each State. The analysis was mainly done by the research staff of the project.

Tool used

The only tools used were information blanks for culling out the facts given in various syllabuses (See Appendix I).

Development and description of tool

A preliminary survey of a few syllabuses was done to find out the types of information that are given in them. The important aspects into which this information could be organised were then decided. The lack of uniformity in the classification of school stages was taken into consideration. Two separate information blanks were developed, one for the elementary stage and the other for the secondary. The information blank for the elementary stage was divided into three broad categories:

1. Objectives of education as found in syllabuses.
2. Objectives of teaching mathematics as found in syllabuses.
3. Arrangement of the content:
   (a) Topics included.
   (b) Scope of the topics.
   (c) Year-wise spread-over of each topic.

The information blank for the secondary stage was divided into following broad categories:

1. Name and status of the subject
2. Examination pattern
3. Components of the subject
4. Objectives of teaching the subject
5. Content.
   (a) Topics and their scope
   (b) Demonstrations, experiments and practical activities.

Procedure

The information given in each syllabus was transferred to the blank form under each of the categories for the purpose of drawing conclusions. Most syllabuses were very sketchy and gave only a list of topics and sub-topics. In such cases an attempt was made to find out the implicit information by studying the general note often given in the beginning of the syllabus, which explains its philosophy and gives suggestions on methods, activities and class organisation. In case of geometry at the secondary stage the theorems and problems included in various syllabuses were checked against a well-known text, for the purpose of knowing the exact scope and load in theoretical and practical geometry. No attempt was made to compare one syllabus against another.

Only significant points were collected and organized into a coherent pattern. Wherever possible, the generalizations were formulated on the basis of both,explicit and implicit facts.

A detailed report of the analysis has been prepared separately.

B. Analysis of textbooks

The purpose of this study was to get an analytical opinion of the teachers about the books in use. The textbook in most cases is the only source of material for instruction. It provides suggestions for development of processes, practice exercises, study helps and tests. It was felt that the analytical opinion of the teachers on these aspects of the textbook will be of immense value in preparing instructional materials on the topics included in the curriculum guide.

Tool used

The only tool used for this study was a questionaire for teachers. (see appendix 2).

Development and description of tool

Whoever sets out to measure the qualities of textbooks soon discovers that not all qualities of a textbook are measurable and no scientifically evolved standards or norms exist for measuring these qualities. Much reliance is to be placed upon the judgement and experience of the examiner. The examiner should know the textbook, and school conditions and should have a set of mental standards by which to judge the various qualities. It was, therefore, thought appropriate to request the school teachers to give their opinions on the books they are using in the class.

For the purpose of securing uniformity in information a questionnaire was prepared by the project staff. For the purpose of developing the questionnaire a preliminary survey of about 30 mathematics books was done. This survey helped in deciding about the various aspects of a textbook into which the information could be organized and in listing items that go under each of these aspects. It was soon realized that for having a detailed analysis or for covering every type of information in a textbook it was necessary to workout lengthy analysis sheets which will take a good amount of time to fill in. Since the purpose was not to compare one set of books with another it was decided not to have very detailed analysis sheets. On the other hand it was felt that the purpose of obtaining opinion of a teacher on the various aspects of the book he is using could be better served by including a few open ended questions.

The first draft of the questionnaire prepared by the project staff was sent to 20 experienced school teachers and lecturers in colleges for their comments. This was modified in the light of the suggestions received. These changes were very minor and did not change in any way the structure of the original.

The questionnaire used in this study is organized under the following heads:

A. General information
B. General organization of the textbook
C. Subject matter
D. Style of writing
E. Pictorial and graphic illustrations
F. Objectives
G. Miscellaneous.

A. General information: authorship, quality of paper, printing errors, language in which the book is written.

B. General organization: relationship of the textbook to the syllabus and sequence of the topics.

C. Subject matter: types of material included- solved examples, practice exercises, problems, testpapers, revision exercises.

D. Style of writing: language of the book and methods used for explaining the concepts.

E. Pictorial and graphic illustrations: appropriateness and accuracy of illustrations and the ways in which they contribute to the understanding of mathematical ideas.

F. Objectives: point of view of the authors in writing textbook.

G. Miscellaneous: Three open-ended questions were put; the first on the continuity of topics from grade to grade, the second on the type of materials the textbook should include and the third on the over-all opinion of the teacher.

The Sample

The questionnaire was sent to about 200 school teachers who were requested to fill in the information with regard to the textbook that is in actual use for teaching elementary mathematics. The response to the questionnaires was not very prompt and reminders had to be sent to persons who did not respond. After waiting for a fairly long time (about three months), only 60 questionnaires were received back from the teachers. A close scrutiny of these questionnaires revealed that in 17 cases the teachers had sent information about a book in mathematics that was in use in a lower class or for teaching optional or advanced mathematics. Therefore for the final analysis only 43 questionnaires were accepted as relevant. The state-wise distribution of these questionnaires is as follows:

Andhra Pradesh	1	Madhya Pradesh	3
Assam	3	Mysore	2
Bihar	1	Orissa	5
Gujarat	9	Punjab	1
Jammu & Kashmir	2	Rajasthan	9
Kerala	2	Uttar Pradesh	1
Madras	4	West Bengal	2

Since the questionnaire did not go into the details of the sources of problems and their adequacy, a detailed analysis of 28 books was done by the research staff. The data collected for eight topics are presented as an appendix to the report on 'Study of Textbooks'.

The procedure of analysis

The information obtained on each questionnaire was transferred to a single-sheet for each category for the purpose of drawing conclusions.

The interpretation suffers from the limitations that accrue to the questionnaire technique of study. In some cases the answers were vague and inconsistent. A detailed report of this analysis has been written separately.

C. Study of the teaching-learning procedures

The purpose of this study was to know as many as possible of the existing teaching-learning practices followed by teachers and students in the study of Elementary Mathematics (the minimum compulsory course). This was considered to be an essential pre-requisite to the actual development of the curriculum for General Mathematics as proposed in the project.

Schools in individual States and the Union Territory were so selected as to cover urban and rural schools and a fair distribution of boys and girls schools. Care was also taken to include both Government and non-government schools. As no comparative analysis was intended this selection of schools was not based on any sampling techniques. In this coverage five languages (used as medium of instruction), viz., Hindi, Gujarati, Kannada, Punjabi and English were involved. This necessitated seeking co-operation from persons from outside the extent possible the co-operating investigators were oriented to the tools employed and one member of the project staff was associated with every co-operating investigator.

From each school one class (or section) was taken up but in three cases two classes were also observed. Thus, whereas the number of schools visited was 39, the number of classes observed was 42.

Tools

The tools used for this study were:

i. A questionnaire for students

ii. Observation of classroom teaching

iii. Interview with teachers

iv. Interview with students in groups

v. List of points for study of student's class and home-work note-books (a sample of ten note-books of each type for each class).

vi. General information blank (See Appendix 3)

Development and description of the tools

This first draft of the questionnaire for students was prepared in English and then translated into Hindi. This was further modified after use in two schools in Bihar, though the structure or the basic questions of the original were not changed in any way. This version was used for the whole study and Gujarati and Kannada versions were also prepared on the basis of this final form. A large majority of the questions had a number of responses listed alongwith and every respondent was required to mark one of the responses that applied to him. A few cases of non-compliance of instructions were, however, observed. In addition, there were a number of open-ended questions too. These questions were kept open-ended purposely because pre-listed responses were likely to vitiate results otherwise expected. For example a question like 'With what purpose in view do you study Elementary Mathematics?' would not elicit a correct responses if the same were listed in the questionnaire, for them the students would select the socially best accepted response. The respondents, at times, did need some help to understand the implications of some questions here or there.

The investigators were given clear instructions on how far they could go by way of explaining the questions and at the same time avoiding any suggestions.

The respondents were questioned on a number of activities connected with the study of Mathematics. To clarify the instructions the investigators were asked to read out the instructions to the students and explain them. One practice item was also to be done under the supervision of the investigator so as to ensure understanding and proper compliance. This was useful for establishing a healthy rapport between the investigator and the respondents and the strain of sitting for about three hours was not very heavy.

In order to know the teaching techniques followed by different teachers, the investigators were required to sit in a class for a full period and record every activity of both the teacher and the students for three minutes at a time. This was expected to be a faithful record of what was done in class, free of any personal bias of the investigator. This record was later analysed on a five-point scale over seven important elements of a lesson. These items were first listed and then sent to 15 Mathematics teachers for comments. Items selected finally were put on a five-point scale for the rating of every teacher.

The schools had information in advance regarding the visit of the research staff. They had been advised not to take the visit as a formal activity but to conduct the school programme go so as to present the normal position in its day-to-day setting. In majority of the cases investigators felt that not much of formality was observed.

But seeing a teacher in one period is not likely to give any complete picture of his work. This handicap was thought to be compensated through an interview with the teacher. Care was taken that interview with the teacher never preceded classroom observation. This restriction had to be imposed because some of the questions in the interview were likely to caution the teacher regarding his teaching technique and could have acted as a suggestion to be formal. The teacher's interview was not a completely structured one. The investigator had the purposes of teacher's interview with him and also the guiding points for the interview. To that extent the interview could be called structured. But at points the investigator had to get information through oblique references to points where some camouflaging was suspected. This probing was not only permitted but was encouraged also. At the end, the investigator would ask the teacher if he had any comments to make. These were also recorded. Throughout this conversation the investigator was assisted by a recorder who recorded almost verbatim the questions and replies to them for analysis at a later date.

As it was quite likely for some teachers to present a very bright picture of themselves, it was considered helpful to have a cross-section of the student group and their narration of the teaching method. For this purpose was introduced another tool - Student's Group Interview.

The selection of students for this group interview was first tried on a random sampling technique. Every student had a serial number corresponding to him in the attendance register. Using a table of random numbers eight students were sampled out for the purpose of interview. A difficulty observed in this technique was that at times not much of an information could be obtained from students so selected. Then one or two students responding quickly to the questionnaire were included in the group. In co-educational classes at least two girl students were included. After talking to these students about the purpose of the visit and the project, the investigator would ask them to narrate in as detailed form as possible, the progress of the last lesson in Arithmetic if the lesson observed was in Arithmetic. As a demonstration the investigator would narrate the day's lesson for about two or three minutes so as to give them an idea of the narration. The need for a factual narration was impressed upon them. The investigator, at intervals, had to intervene to keep the narration continuous and relevant. If any significant point was found missing, the investigator asked questions to elicit further information after students' narration.

Similar narrations for last lessons in Algebra, Geometry and other branches were asked for. The recency of the last lesson was an important factor affecting the completeness of the narration. Throughout the group interview, a recorder recorded completely the conversation between the investigator and the group. Here, again, the general purposes of the group interview were to be kept in mind by the investigator. Otherwise, the interview would have been a narration by the students intermittently interrupted by the investigator's probing questions. In the end the students also were asked to comment on Mathematics Education. This technique of group interview involved an inherent difficulty of students eulogizing a teacher otherwise feared. At times, if a student came out with some information which the others resented, they would throw hints to him not to do so.

Although teacher's interview and students' group interview helped in getting a good deal of information on the teaching techniques and some on written work, it was found that a more reliable source of information on the latter could be home-work and class-work note-books. Ten note-books of each type were collected and studied for regularity of assignments and checking, quality of checking, homogeneity or otherwise of assignments, etc. All the information collected through the above tools concerned only one class or section and the teacher who taught it. But some knowledge of the students strength and those offering mathematics, along with the results in the final examination could help to see the class from a broader perspective. For this purpose information was collected in a simple blank form.

SECTION II

(Development of the New Curriculum)

In our country, generally, the syllabus is prepared by a group of persons appointed by someone in authority and stated in terms of topics and sub-topics which the teachers are urged to cover in quantity and sequence. Recently, dissatisfaction has been expressed both on the procedure and on the outcome of "syllabus revision". However, no systematic effort has been made to develop a curriculum on scientific lines.

This project is the first conscious effort to approach curricular revision from a broad view where attention has been given to both the process and the product. The word 'Curriculum' has been used to include all the experiences which can be offered to pupils under the direction of the school. Therefore, great attention was given not only to thinking in terms of addition or elimination of topics but to the identification of these principles of psychology, sociology and subject matter, which are basic in any decision on curriculum. The stages as envisaged in the plan for the development of curriculum were:

1. Formulation of objectives.
2. Selection of learning material.
3. Selecting suitable learning experiences.
4. Selecting suitable material for evaluation of the curriculum.

All through the implementation of the project, attempt was made to involve in various ways teachers, subject specialists and other persons interested in mathematics education. Some persons contributed helpfull to group discussions; others worked as resource persons; some others assisted in writing and editing materials; and still others worked on the development of units.

A curriculum guide, containing a statement of the thinking as it emerged out of the deliberations and discussions held under the project, about the learner, principles of teaching and learning, and the social forces and also the proposed content, has been prepared separately.

In the following pages a brief account of the steps, procedures and criteria followed at the various stages is given.

i.

1. FORMULATION AND SPECIFICATION OF OBJECTIVES

Aims and objectives were our guide posts. Recent literature and also the analysis of syllabuses, textbooks and teaching-learning situations conducted in the project, revealed lack of significant and realistic purposes and goals of instruction. Accordingly, great importance was given in this study to reformulate the objectives of teaching mathematics. The underlying premises in formulating the objectives of teaching mathematics were:

i. that the goals and objectives of teaching mathematics must of necessity have a direct bearing on the objectives of general education. The study, however, does not propose to be a complete analysis of the nature of society and culture. Only a few salient trends and conditions of our society and culture as are feflected in avowed goals of general education were analysed for the purpose of this study.

ii. Mathematics education has been passing through a period of unprecedented change in content and methodology all over the world. The objectives were, therefore, considered in a broader context of emerging trends.

Methods used in determining objectives

The following two methods were mainly used:

i. Survey of competent opinion.

ii. Analysis of materials.

Criteria used in formulating objectives.

Objectives are, in one sense, the changes in a pupil that we try to bring about through education. Therefore, it was thought necessary that the set of objectives formulated should

i. indicate both the desired behaviour and the type of situation in which it is to occur.

ii. be expressed in terms of desired pupil behaviour rather than of teacher behaviour.

iii. be specifically stated so that it is possible to infer some appropriate learning activity.

Steps

1. A general description of the situation in which the objectives are to be operative was secured. This involved a detailed consideration of the three bases - psychological, sociological and subject matter.
2. A list of tentative objectives from which valid selections could be made was prepared.
3. The important objectives were identified.
4. The objectives were clarified in terms of desirable pupil behaviour.
5. A two-dimensional chart showing content and behaviour aspects of objectives was prepared.

Procedure

1. The first step in the study was the examination of the important components in the educative process - learner, society and subject matter. The study was confined to the following specific aspects:

A. Psychological Foundations

i. Factors related to child

a) Growth characteristics

b) Needs and interests.

ii. Factors related to learning.

a) Process of learning

b) Principles of learning

c) Motivation.

d) Individual differences.

e) Principles of Drill.

f) Problem-solving.

iii. Factors related to evaluation of learning.

B. Sociological Foundations.

a) Nature of mathematics.

b) Basic concepts in mathematics

c) New trends in the subject.

A. The most pressing task of mathematics education is to make it adequately effective by basing it on sound principles and practices of learning. The analysis of teaching-learning situations confirms the view that mathematics education lacks effectiveness, variety and richness. A number of seminars held under the All India Council for Secondary Education and the Directorate of Extension Programmes in Secondary Education during some time past also point to the increasing consciousness of the educational personnel to the problems of learning mathematics.

The research literature pertaining to each aspect was studied and its implications for formulation of objectives and their attainments were considered. The views on each of these aspects were further shared with teachers and lecturers in training colleges in the seminars organized under this project. A detailed discussion on these aspects was held at the Mysore Seminar. The final statement as it emerged out of the study and discussions has been included in the curriculum guide.

B. As already pointed out, the mathematics curriculum has an obligation towards the attainment of aims of general education. So it was thought desirable to discern important social trends and conditions underlying the avowed national goals of education and study their implications for mathematics education rather than getting into the basic issues of social change and values (Appendix 4). The statements of national goals of education could be located in a number of publications such as the Secondary Education Commission report and the working papers circulated by the Education Commission appointed by the Government of India. These statements seek to provide for the maximum development of the individual whereby he will contribute most towards the progress of society. A study of these statements thus implied an assessment of the needs of the individual as well. However, other statements of needs of the individual were also studied.

The literature pertaining to each aspect was studied and its implications for formulation of objectives and their attainment were considered. The views on each of these aspects were further shared with teachers, lecturers and others during the various seminars and meetings held under the project.

The study of sociological foundations had great implications for both the content and behaviour aspects of objectives. It helped in arriving at the basic assumptions underlying the curriculum and in listing important understanding, skills and attitudes that flow out of them as part of the mathematics curriculum. It could be easily seen that some of these understandings, skills and attitudes form part of the content of mathematics and some lay emphasis on mathematics as a method. Thus the study of social foundations helped in justifying the selection of variety of objectives and in listing specific outcomes pertaining to the two related aspects, mathematical and social, of mathematics education.

C. Another source of objectives is the accumulated knowledge of the scholars. Subject-matter specialists have developed a vast reservoir of knowledge from which information to be learned and understandings to be gained can be selected. Mathematics education all over the world is in a state of ferment and far-reacing changes are being brought about in the content as well as in the method. Therefore, the study of 'new thinking in mathematics' was given a special place in this project. The reports of various international seminars and new materials produced by experimental groups were closely scrutinized to get a clear understanding about the nature of change.

A list of ideas, concepts and information which are significant and pertinent to the understanding of the nature of mathematics was prepared and its implications for objectives were worked out. Besides, it was recognized that the nature of mathematics has certain characteristics which must find justification in the objectives so that the gaps that exist in present-day teaching and testing are avoided.

The points arising out of the study of literature on various aspects were further discussed with teachers, lecturers and subject specialists. The study of subject-matter foundation helped in justifying the selection of variety of objectives and in listing specifications there under. It also helped in suggesting criteria for selecting content and learning experiences.

2. The second step was to secure a tentative list of objectives. For this purpose the objectives formulated by participating teachers and other educators in 28 workshops held in the past all over the country and the objectives given in various syllabuses and textbooks on methods were listed and analysed (Appendix 5). The initial list contained about 92 statements of objectives. Some of these were more general than others. Some were so specific that they could be called objectives for a particular topic Each statement in the list was scrutinized in terms of its level of generality, and its appropriateness was judged in the list of level of generality reflected in content as well as in behaviour from the study of the three foundations.

3. The third step was to analyse and classify important statements. For this purpose the statements were grouped under the six broad catagories: (i) Knowledge, (ii) Skill, (iii) Application (iv) Appreciation and interests (v) Attitudes and (vi) Personality and character. (Appendix 5) Although objectives in all these categories are worthy of achievement, it was thought that limitations of time and resources may not enable teachers to achieve that target in the very beginning. Therefore, it was thought proper to lay more stress on the first three categories and bring in the others as and when feasible.

A set of objectives were formulated in the context of the needs of the pupil, his background (as studied in step I), and the analysis of the statements obtained from various sources as collected in step 2.

The objectives were expressed in clear and unambiguous terms so that they might not appear too general or vague and might indicate clearly what the pupil is expected to achieve. The number of objectives to be aimed at was not fixed, the purpose being to accommodate all important knowledge, skills and application aspects of subject. The list is only suggestive. The number of objectives to be aimed at was not fixed, the purpose being to accomodate all important knowledge, skills and application aspects of subject. The list is only suggestive and is capable of being enlarged according to changes in needs and availability of resources.

4. The fourth step was to express them in specific terms in relation to the behaviour changes of the pupil, i.e. changes instruction should bring in the child's thought, feeling and action. In specifying the Objectives in terms of behaviour change the following criteria was kept in view:

(a) It should flow from the objective

(b) It should make clear what is implied in the objective

(c) It should indicate what exactly the pupil should do to attain it and after the objective is attained by him.

(d) It should be appropriate to the level of pupil's development.

The tentative list of objectives and their specifications thus prepared was referred for comments and suggestions to about 40 persons including teachers, headmasters, lecturers in training colleges, and scholars. The improved list was further put to detailed discussion at the various seminars held under the project. The final statements of objectives and their specifications have been included in the curriculum guide.

5. After the objectives were selected and defined in terms of pupil behaviour, the next step was to check if all these were covered by the essential content matter proposed. Content matter is the media through which we propose to achieve the objectives, i.e., bring about desirable

changes in the pupil. (Appendix 6). The relationship between content and behaviour aspects of the objectives was then presented in a two-dimensional chart which helped in selecting appropriate learning experiences.

2. SELECTION AND ORGANIZATION OF THE LEARNING MATERIALS

The above objectives can be realized only if proper content is selected for curriculum. The underlying premises in selecting the content for the curriculum were:

1. In all States courses in general mathematics already exist, so there is no question of building a completely new curriculum. The development of curriculum, in practice, would mean to modify, add, subtract and restructure the existing programmes. Such a limitation has been also indicated in the plan: "one of the prerequisites of this project is to have as less variations in the existing syllabuses as possible so that the new experimental curriculum can be tried out fully and in a realistic situation in these regions."
2. We are mainly concerned with the development of curriculum for secondary classes. However, such an attempt will be futile if subsequent changes in the curriculum for the elementary classes are not visualized. The curriculum proposed here has therefore been guided by the new directions the elementary school programmes are taking and does not depend entirely on the existing programmes.
3. There is no uniformity with regard to the duration of general mathematics, which varies from a one-year course to a four-year course. The content for the present curriculum has been, therefore, selected for four years, corresponding to classes VIII, IX, X and XI in States which follow the seven-year elementary pattern.

Criteria used for selecting and organizing the learning material

1. The selection of suitable content very much depends upon those basic considerations that underlie the formulation of objectives. The objectives recognize four significant aspects of mathematical learning - concepts or meanings; computational skills; problem-solving (reasoning) and attitudes. Concepts play an important role in the reasoning and also facilitate the learning of computational skills. The emphasis on meaningful learning as is implicit in the objectives demands, in turn, emphasis upon the conceptual aspects.

   The objectives lay emphasis on the social applications of mathematics. Social applications as envisaged in the objectives are not restricted to traditional uses of mathematics in problems of personal finance, home, business and government. Rather, great emphasis has been placed upon those basic concepts and skills of mathematical thinking and problem-solving that most people should know in order to function intelligently as members of society. The content of the programme in general mathematics should include all those elements of mathematics that most people have occasion to use and that help in learning new skills which the future will demand of many of them.

   Further, the objectives recognize the recent trends in mathematics education that put greater emphasis on the basic structure of mathematics and on looking at mathematics as one indivisible whole in which the many skills and techniques composing it are tied together by a few basic ideas.

Thus, an analysis of the objectives clearly shows the importance of concepts in effective learning of mathematics, in usefulness of mathematics and in preserving the nature of mathematics. It was, therefore, thought proper to select a few basic strands of fundamental concepts which run through the entire curriculum and present content around them.

2. A second force that has guided the choice of content is the new thinking now going on in school mathematics. A few of the recommendations taken into considerations/ are as follows:

(a) The time spent on Arithmetic should be saved by not including Arithmetic as a separate entity. Problems and topics of social usefulness that were so far included under Arithmetic should not be used as the basic pattern for organization and presentation of mathematical subject matter.

(b) Greater attention should be given to the nature of Mathematics. We have been teaching Mathematics very much from the point of view of its use as a 'tool' or of its utility with emphasis on developing skill in computation by the application of fixed rules or in mechanical manipulations of symbols. Emphasis is now necessary on basic properties of number system, formal properties of operations, axiomatic exposition, rules of deduction and more precise definitions. Also, the use of clearly defined terminology and the employment of precise symbolism through the language of sets should be accepted.

c. In Algebra, today, much time is spent on a large number of complicated and unnecessary sums requiring only mechanical manipulations such as factorization, H.C.F. and L.C.M.; square root, ratio proportion, elimination, surds, indices. All this should be discarded here in favour of emphasis on basic ideas such as variable, function, relation, equation and inequalities and the development of an appreciation of the structure of algebra stressing the commutative, distributive and similar other properties and axioms.

d. In view of the fact that the utility of Euclid's geometry has been seriously questioned, it has been suggested here that greater emphasis may be put on the axiomatic structure and the nature of proof. Basic ideas, such as symmetry; similarity; congruence; inductive discovery and deductive proof; meaning of 'if and only if', 'if then'; theorem and coverse of a statement; definition and postulate; should be stressed in keeping with the modern spirit of the subject. No sharp distinction is desirable between Algebra and Geometry. Analytical methods should be used thoughout the Geometry. Also, whatever possible, Plane and Solid Geometry should be treated together.

e. Trigonometry should be related to Algebra and much of the work on identities, solution of triangles, etc. should be eliminated. Greater emphasis should be given to the study of trigonometric and logarithmic functions.

f. The idea of co-ordinates should be introduced early as much work in Algebra and Geometry now needs to be integrated through the use of co-ordinates and graphic representations.

g. Statistical notions, such as averages, mean, median, mode, dispersion, etc., and probability should be introduced in consideration of their growing usefulness in life.

Methods Used

The following methods were used in the selection of content.

1. Judgmental procedures.

   These involve extensive group discussions and deliberations; critical evaluation of objectives.

2. Analytical procedures

   This procedure consists in analysing activities and other subject areas to discover what mathematics is used; analysis of most recent programmes and materials.

3. Consensus and beliefs

   It involves securing information on what the opinions of people are as to what the curriculum should be.

Steps

1. The first selection of learning material was done along with the formulation of objectives on the basis of psychological, and subject-matter foundations.
2. The content of elementary school mathematics was examined and important strands identified.
3. The content of present syllabuses in general mathematics was examined in the light of the criteria selected on the basis of sociological and subject-matter foundations.

   It helped in deciding questions such as what topics should be eliminated, what topics should be treated in greater depth, what new topics should be introduced.

4. The content tentatively selected was checked for its utility in other subjects and in important activities of life.

5. The content was then validated by seeking opinion of scholars and subject specialists.

Procedure used in

A. selection of learning material

1. As indicated earlier, an objective has two aspects; content and behaviour. Therefore, along with the formulation of objectives some decisions were taken on the possible content that would make the attainment of objectives possible in consonance with the thinking on the nature of learner and learning and the needs and the subject matter. The content so selected was put in the form of understandings, skills and attitudes (Appendix 7). These reckoned first with the discipline itself and secondly with the nature of the learner and his needs and lend support to the criteria laid down for the selection of the content.

These understandings, skills and attitudes were put to further analysis to arrive at specifics in form of topics or broad content areas from which topics could be selected. For example, understandings No. 11, 12, 13 and ability No. 4 (Appendix 7,), which relate to the language aspect of mathematics, suggest topics such as symbolism, set notation, graphs, number system, geometric forms, etc.

2. The list of the specific topics or broad content areas was then scrutinized in the light of the topics included in the syllabuses for elementary classes in order to locate which of these topics or broad areas have already been introduced to pupils before they reach secondary schools and at what level they have been treated. This helped, further, in locating important strands around which the content should be organized and in listing concepts that should be emphasized. (Appendix 8) Most of these strands such as, concept of

number and concepts basic to operation and unifying ideas for all the school years. In such cases the study of content in elementary classes helped in specifying the concepts and the level at which they have been already treated and in working out their extension to higher levels in the light of the accepted criteria.

3. At this stage the content in existing syllabuses in general mathematics was also examined in the light of the criteria selected. It helped in finding answers to questions such as what topics should be eliminated, what topics should be treated in greater depth and what new topics should be introduced. (Appendix 9).

4. A tentative list of topics was prepared in the light of the content suggested by the analysis of objectives and existing syllabuses. This tentative list of topics was further checked for its utility. For this purpose a few subject areas such as, Physics, Chemistry, Geography, and a few activities of life were examined and important mathematical concepts used in them were listed. (See Curriculum Guide) A few persons which included subject teachers, business men and common men were also interviewed to tell in brief which included subject teachers, business men and common men were also interviewed to tell in brief what they think to be important in mathematics.

The tentative list of topics was also checked against the lists of basic competencies found in books and other literature (Appendix 10).

5. The list of topics was further presented to a group of scholars and subject specialists for comments. A final list was then drawn up in the light of the suggestions made by experts.

Much of the work in connection with analysis of objectives, syllabuses, subject areas, life activities was done by the research staff. But the views were shared with teachers, lecturers and subject specialists who were invited to various seminars and meetings.

B. Organizing the learning material

The criteria listed for the selection of content emphasise mathematics as one indivisible whole in which the many skills and techniques composing it are tied together by a few basic ideas or strands. These fundamental concepts run through the entire curriculum. It was, therefore, thought proper to organize the learning materials under these strands.

The learning material was spread over four years. The continuity and sequence of the learning materials was mainly determined by the logic of the subject, since in mathematics it is easy to find out (i) what need to be reinforced in the course of learning which had begun in earlier courses and (ii) what ought to be reinforced and treated further. In brief, the logical continuity in mathematics facilitates looking in both directions.

The scope of the topics selected under various strands was further specified in terms of the concepts, principles, processes, etc.

3. WORKING OUT LEARNING EXPERIENCES

The achievement of the objectives already elicited and further clarified into behaviour changes depends upon suitable and well-organized learning experiences which are presented to the pupil in order to produce effective learning. The concept of learning experience as it emerges out of the thinking about the learner and the learning principles accepted as the basis for objectives, can be broadly described as a desired change in the mental make-up of a child and it can be brought about through "activities leading to the discovery of connections, relationships and meanings which have significance in the directing or ordering of conduct."

Learning experiences, as envisaged here, place great importance on the pupil and the learning situation, instead of on the teacher and the content.

The proper organization of learning experiences depends upon a number of factors such as the needs of a particular community, abilities of children, facilities available, in the school, which widely differ from place to place. As such the learning experiences listed for various units should not be accepted as exhaustive. They only indicate a few sample activities, which are likely to cause effective learning and [illegible] help in achieving the proposed objectives.

Each teacher should feel free to adjust the objectives, content and activities to suit his requirement. The pattern of his teaching should, however, always follow the sequence which may be summarized as follows:

1. Select the objectives and clarify them in terms of pupil behaviour.
2. Select and organize suitable content for these objectives and behaviours.
3. Select appropriate learning situations and activities for the pupils.
4. Evaluate the outcomes of these activities.

Criteria used for Learning Experiences

The following criteria was kept in view in selecting and organizing learning experiences:

1. Learning experiences should be appropriate to behaviour changes defined under objectives.
2. They should be suitable for the content area.
3. They should be practicable.
4. They should be adequate and effective.

It was difficult to lay down specific criteria for judging practicability, adequacy and effectiveness of learning experiences. Much reliance was, therefore, put on the judgement of the teachers who framed them.

Methods used

The following methods were used:

1. Analytical procedures

These involve analysis of books, other materials and areas of life with a view to locate typical activities and problems.

2. Judgmental procedures

These involve extensive group discussions and deliberations and evaluation of objectives.

Steps

1. The topics selected for the content were organized into suitable units or sub-units taking into consideration the relationships between the various topics.
2. The objectives of the unit were then selected keeping in view the two-dimensional chart showing the nature of content and behaviour.
3. The content of the unit was then analysed into specific understandings, skills and attitudes.
4. Different activities that give the maximum opportunities for children to develop desired behaviours were then suggested.

Procedure

Before proceeding to the actual selection of learning experiences, agreement was secured on a number of factors which are basic to effective learning, viz., motivation, drill, memorization, problem-solving integration, etc. A number of practical suggestions on these aspects have been listed in the curriculum guide for the guidance of teachers.

For the planning of learning experiences it was thought necessary to organize the content into suitable learning wholes and call them units. Units have been selected on the basis of logical relationship of various mathematical ideas. It is, however, possible to further break up a unit into smaller sub-units. Every teacher has to work out his own unit keeping in view the needs of the pupils, resources and purposes. The units planned here were selected with a view to cover the most important ideas of the content and indicate the typical learning experiences. These are, therefore, suggestive and not exhaustive.

The preparation of teaching units was taken as a culminating activity for each seminar. Soon after the participants had accepted the objectives and suggested content, they were asked to plan a few teaching units to check if the various objectives are attainable by the proposed content. This involved working out suggestions for pupil activities which ensure the attainability of objectives.

These units were checked by the research staff for the correctness of the terms, definitions, principles, etc. and the appropriateness of the objectives proposed for the unit and suggested learning activities. Not all the units prepared by the participants could be accepted. Also, for some of the new topics included in the content such as sets, inequalities, functions, etc. units were prepared by the research staff.

A number of textbooks in mathematics and other subject areas were also examined to select typical problems and activities for the units.

The main consideration in planning units has been on being selective in the objectives and making provision for learning experiences which are necessary. No attempt was made to include everything possible as too much coverage reduces the effectiveness of the units.

4. EVALUATION OF THE CURRICULUM

As already indicated, the tryout of the curriculum was not taken up at this stage. Therefore, no detailed study and preparation of evaluation tools was undertaken.

Evaluation and curriculum are regarded as closely related parts of the same educative process, not as distinct and separate functions. No curriculum can therefore be said to have been planned without laying down some basic principles of evaluation.

Some time was, therefore, devoted to the discussion of the concept of evaluation and how it should be applied in mathematics. Important points that the teacher should keep in view while assessing student progress in mathematics have been included in the curriculum guide.

For the past few years a number of workshops have been held all over the country by DEPSE in order to improve the examination system. The climate created by these workshops and the training that a large number of teachers got through them were of great help in arriving at an agreement on the basic principles of evaluation that can be usefully applied in assessing the students' progress.

Methods used

1. Analytical procedure

This includes analysis of (i) workshop reports (ii) objectives, and (iii) books and other materials

2. Judgmental procedure

This includes discussions and deliberations with teachers and asking them to write items for tests.

Procedures

Evaluation comes in at the planning stage when objectives are identified. Therefore, the concept and methods of evaluation came up for discussion after the objectives had been identified for the purpose of the curriculum. The differences between the various objectives were identified and several behavioural changes were listed. The suitability of the behavioural changes was examined in the context of the accepted thinking about learner, his needs and the subject-matter.

A number of evaluation devices were then discussed and their suitability for the types of behaviours listed was worked out. The suggestion for evaluation procedure were also worked out. A number of test items for specific behaviours were also prepared by the teachers who participated in the discussion during the various seminars.

5. SEMINARS AND WORKSHOPS

The common method of bringing out change in syllabus utilizes specialists only. A committee of specialists is appointed which after going into the various aspects announces a revised syllabus which in most cases amounts to addition of a few new topics and dropping out of a few old topics. One of the main emphasis in this project was on making curriculum study a cooperative study on the part of teachers, subject specialists, psychologists and others. Due recognition was given to the role of teachers by organizing a number of seminars/workshops and seeking their cooperation in various tasks. The tasks include interpretation of curriculum objectives and the selection of suitable experiences, activities materials of instructions, and methodology. Meetings were also held with subject specialists, psychologists, and others. Apart from holding seminars/workshops and conferences of these persons, informal contact were made althrough the project with other persons interested in the improvement of mathematics education. These included members of the Panel on Mathematics education. These included members of the Panel on Mathematics Textbooks, UNESCO experts, persons who attended the Summer Institutes in mathematics, persons working in various departments of N.C.E.R.T., etc.

The following important workshops and conferences were held under the project.

1. A workshop was held at Ahmedabad from 20th October to 24th October, 1964. It was attended by about 25 participants. The workshop discussed in the following:
    a) Concept of General Mathematics - its status, scope and importance.
    b) Objectives of teaching the subject and their specifications.
    c) Content for the syllabus
    d) Teaching units.
2. A workshop was held at Mysore from Ist Feb. to 10th Feb. 1965. It was attended by about 17 participants. The main purpose was to discuss the Psychological, Sociological and subject-matter foundations and make out a point of view with regard to such aspects of teaching that are basic to the achievement of the objectives. Participants were asked to write papers on various aspects. These papers were read in the workshop. The following are a few of the topics discussed in the workshop.

Learning - kinds of learning and its relation to teaching of mathematics.

Motivation

Drill

Problem-solving

Expectations of the society with regard to general education in mathematics.

Cultural values of mathematics, Nature of mathematics,

Language of mathematics, New trends.

3. A workshop was held at Udaipur from 27th May to 5th June, 1965. It was attended by about 15 participants. The purpose of the workshop was to finalize the list of topics for the curriculum, select and organize suitable learning materials and prepare teaching units.

4. A meeting of about 12 teachers of different subjects was held at Delhi from 28th December to 31st December, 1964 to give their comments on the topics included in the proposed curriculum and suggest situations from different subjects in which mathematical concepts are used.

5. A meeting of subject specialists, teachers and administrators was held on August 22, 1965 to get their comments on the draft of the syllabus and placement of topics.

6. STAFF POSITION

The following staff was sanctioned under the project:

Research Associates	3
Technical Assistants	2
Typist	1

In the early stages the project was conducted at IEPSE under the directions of Dr. R.H. Dave, Dy. Director. The project was transferred to the Department of Curriculum, Methods and Textbooks in the month of October 1964. and Shri R.C. Saxena, Research Officer was asked to conduct it. Later on a post of

Principal Investigator was sanctioned and Shri R.C. Saxena was appointed Principal Investigator w.e.f. 14th April 1965.

The recruitment of the staff started in Dec. 1963. The staff position during the project is summarized below:

	Staff	Date of joining the project	Date of leaving the project
1.	Research Associate	31st Jan 1964	On completion of the project, i.e., 31.12. 65
2.	Research Associate	2nd March 1964	Jan. 1965
3.	Research Associate	June 1964	June 1965
4.	Technical Asst.	3rd Dec. 1963	Till end, i.e., 31.12.65
5.	Technical Asst.	13th Dec. 1963	On completion of the project, i.e. 31.12.65
6.	Typist	17th Dec. 1963	Till end, i.e., 31.12.65
Substitutes			
1.	Research Associate	25th Aug. 1965	On completion of the project, i.e., 31.12.65
2.	Research Associate	28th Aug. 1965	On completion of the project, i.e., 31.12.65

It is clear from the above that the staff was stable during the first year of the project when most of work was completed towards the Analysis of the Present Position.
The staff position became unsatisfactory because of the departure of two Research Associates in early 1965 when work was started on the development of the new curriculum. The difficulty was felt more during the period June 1965 to Dec. 1965 when most of the work in connection with the content materials, scope and the teaching units was done which required a fairly high level of competence in the subject. None of the Research Associates had touch with new content and the new thinking now going on in the field of mathematics education. All these factors resulted in slowing down the progress of the project towards the end. The project was extended by three months and came to an end on 31st Dec. 1965.

....38/-

THE STAFF OF THE NIE-HEW PROJECT NO. 009

1.	Mr. R.C. Saxena	Principal Investigator
2.	Mr. D.N. Abrol	Research Associate
3.	Miss M.S. Shah	Research Associate
4.	Mr. A.P. Chaudhary	Research Associate
5.	Mr. M.S.Yadav	Research Associate
6.	Mr. Surinder Mohan	Research Associate
7.	Mr. Ishwar Chandra	Technical Assistant
8.	Mr. G.D. Dhall	Technical Assistant
9.	Mr. Har Bhagwan Gakkhar	Lower Division Clerk.

APPENDIX I.

INFORMATION BLANK

FOR THE ANALYSIS OF THE SYLLABI IN MATHEMATICS

for

PRIMARY AND MIDDLE CLASSES

Name of the State where the Syllabus is in force ______________________

The year in which it first came into force ______________________

Name of the public examination, if any, to which it may relate. ______________________

---

1. Criteria Related to the purpose and Functions of the Primary Schools

1. Does the curriculum or the Course of Studies indicate the major purposes of Education at this stage? Yes/No

2. If it does, please mention these.

   i.

   ii.

   iii.

   iv.

   v.

3. Do the objectives listed in (2) cover the following aspects?

   (i) acquisition of knowledge Yes/No

   (ii) attitudes and skills Yes/No

   (iii) healthy citizenship Yes/No

   (iv) good character, work habits etc. Yes/No

   (v) preparation for future Yes/No

4. Does the Syllabus indicate or explain the objectives of teaching Arithmetic in the primary school?

5. If it does, please mention these.

Contd...2/-

i.

ii.

iii.

iv.

v.

6. Do the objectives listed above give consideration to the following?

(i) Bsic concepts & understandings of Arithmetic Yes/No

(ii) Use of Knowledge Yes/No

(iii) Problem solving ability Yes/No

(iv) work habits Yes/No

(v) Development of language Yes/No

7. Does the Syllabus lay amphasis on

i. computational skills and ability? Yes/No

ii. understandings and meanings?

iii. step-by-step development of each concept? Yes/No

iv. the language aspect of number? Yes/No

v. work habits, e.g. neatness, thoroughness, checking, results, etc.? Yes/No

vi. problem-solving skills? Yes/No

II. CRITERIA RELATED TO THE SELECTION OF SUBJECT-MATTER

1. Is the subject-matter organized as:

i. topics, further sub-divided into smaller ones? Yes/No

ii. units of living? Yes/No

iii. concepts, understandings and skills to be developed? Yes/No

2. Is the subject-matter selected from

i. the basic concepts of arithmetic? Yes/No

ii. the daily experience and activities of children? Yes/No

contd....3/-

iii. problem from every-day life and environment? Yes/No

iv. other school subject? Yes/No

v. a source other than the above? yes/No

3. In which class or classes does the syllabus cover the following topics? Yes/No

1. The Number System ....in classes........
2. Addition in classes ....
3. Subtraction in classes ....
4. Multiplication in classes ....
5. Division in classes ....
6. Measurement in classes ....
7. Fractions in classes ....
8. Decimals in classes ....
9. Business usage in classes ....
10. Graphs, Tables etc. in classes ....
11. Geometrical concepts in classes ....

4. Does the Syllabus also indicate the scope of each topic in each class? Yes/No

5. If so, how is it done? Please give examples also.

i.

ii.

iii.

6. Does the Syllabus give consideration to

i. the age-level of child? Yes/No
ii. his social needs? Yes/No
iii. the nature of the learning process? Yes/No
iv. latest findings about the child? Yes/No
v. individual differences? Yes/No
vi. role of mathematics in the life of man? Yes/No

7. Is the subject-matter well graded? Yes/No

8. If the subject-matter is graded, which of the following principles of grading have been followed?

i. levels of the difficulty of each topic Yes/No
ii. inter-relationship of the various topics Yes/No

9. (a) Does the syllabus lay emphasis on revision? Yes/No

(b) If yes, then it is done,

(i) by use of a statement, 'Revision of work done in previous grades'. Yes/No

(ii) For each topic, which results in additional drill. Yes/No

(iii) as preteaching of concepts necessary for the learning of new concepts. Yes/No

10. Does the Syllabus lay emphasis on problem-solving? Yes/No

11. What kind of problem does the Syllabus envisage?

i. those based on the direct experiences of the child (e.g. in craft-work, graderning, etc.) Yes/No

ii. those based on his indirect experience (e.g. playway shops, buying-and-selling activities specifically organized). Yes/No

iii. such as are not based on his experiences. Yes/No

iv. any other source not indicated above. If so, please mention it below.

III. CRITERIA RELATED TO THE CHILD'S BEHAVIOUR AND EXPERIENCES

1. Does the Syllabus recognize individual differences in children? Yes/No

2. Does the Syllabus leave scope for self-directed individual projects or hobbies? Yes/No

3. If it does, please indicate which of the following projects or hobbies are referred to?

i. Number games and exercises Yes/No

ii. Stories, like the story of number, of the calender, etc. Yes/No

iii. Magic squares. Yes/No

iv. Collection of coins or stamps Yes/No

v. Construction of simple geometric designs. Yes/No

vi. Making a flower or vegetable garden Yes/No

vii. Any other similar activity. (Please mention below) Yes/No

4. Does the Syllabus suggest a variety of materials? Yes/No

5. Which of the following varieties are suggested?

   i. Manipulative material useful for counting and grouping. Yes/No

   ii. Manipulative material like charts, models, collection of things etc. Yes/No

   iii. films and film strips. Yes/No

IV. CRITERIA RELATED TO ORGANIZATION FOR TEACHING.

1. Does the Syllabus have any indications regarding the teaching plan? Yes/No

2. Does the Syllabus give any suggestions on teaching problems? Yes/No

3. Does the Syllabus suggest any reference material that teachers should consult? Yes/No

4. If the answer to the above is 'yes', which of the following types are suggested?

   i. textbooks other than the one prescribed. Yes/No

   ii. textbooks prescribed for higher classes. Yes/No

   iii. Magazines and journals. Yes/No

   iv. books on methodology. Yes/No

   v. film catalogues. Yes/No

   vi. any others not indicated above. (please write below)

NOW YOU HAVE STUDIED THE SYLLABUS UNDER FOUR CATAGORIES. WHAT WOULD YOU SUGGEST FOR THE IMPROVEMENT OF THE SYLLABUS?

APPENDIX I

INFORMATION BLANK

FOR THE ANALYSIS OF THE SYLLABI IN MATHEMATICS

________ for ________

SECONDARY CLASSES

Name of the state where the syllabus is in force ________

The year in which it first came into force ________

Name of the public examination, if any, to which it may relate. ________

I. NAME AND STATUS OF THE SUBJECT

1. Is it a compulsory subject? Yes/No
   If so, what is its name? ________

2. Are there any restrictions for this course? Yes/No
   If so, mention them.

3. Does the subject have an independent status? Yes/No

4. (a) What is the duration of the course? ____years

   (b) In what classes is it included? ________

5. How much time is allotted for week? ____periods per week

II. Examinations

1. Which practices are observed for the assessment of students?

   (i)

   (ii)

   (iii)

2. What is the number of total marks alloted to general mathematics at the examination? ___marks

   Mention the distribution of marks

for the external and internal assessment.

External ________ Internal ________

3.(a) Is there only one paper at the final examination. Yes/No

If not, how many papers are there? ___papers

(b) Of how many marks is one paper? ___marks

4. Is there a break-up of marks given in the syllabus? Yes/No

If yes, how many marks are allotted to each of Arithmatic, Algebra, Geometry, Mensuration, Trigonometry, statistics and assessment?

Arithmetic __________ marks

Algebra __________ marks

Geometry __________ marks

Mensuration __________ marks

Trigonometry __________ marks

Statistics __________ marks

Assessment __________ marks

5. At the end of which class is the examination held?

6. Are there some concessions offered to students for the purpose of qualifying at the examination in general mathematics? Yes/No

If so, mention them.

7. Does the syllabus mention minimum pass marks? Yes/No

If yes, what is the percentage of minimum pass marks? ___%

8. As compared to other core (i.e. compulsory) subjects, is general mathematics given equal weightage (100 marks)? Yes/No

If so, mention the core subjects other than general mathematics and marks for each.

Core subjects other than General mathematics marks for each

If not, indicate the weightage in marks.

8. Core subjects other than General mathematics marks

III. Components of the Course.

1. Mark 'J' against the subject areas covered in the general mathematics course.

Arithmatic

Algebra

Geometry

Statistics

Mensurations

Trigonometry

2. Is the content in each area arranged class wise? Yes/No

3. Are there few sub-topics also mentioned under each topic. Yes/No

IV. OBJECTIVES OF TEACHING THE SUBJECT

1. Are the objectives of teaching the subject mentioned in the syllabus? Yes/No

If so, mention them.

V. Analysis of Content.

Indicate the number of topics in each subject area and list them.

1. Arithmatic
2. Algebra
3. Geometry
4. Statistic
5. Any other.

2. Is the content in Geometry divided into theoretical & practical parts.

If so

Indicate the number of theorm and construction

(N.B. check each list against Hall & Stevens scheme of theorems & constructions)

3. Are there any suggestions for demonstration experiments and practical activities?

If so, mention them.

4. Are there some suggestions for Teachers and Authors given in the syllabus? Yes/No

If so, mention them.

5. Are there any suggestions for equipments to be used in the study of the subject given in the syllabus? Yes/No

If yes, mention them.

6.(a) Does the syllabus give any suggestions regarding books?

If so, please mention. Yes/No

(b) Does the syllabus list recommended books? Yes/No

If so, what is the number of them? ________

(c) Does the syllabus list reference books? Yes/No

If so, please mention the number of them.

APPENDIX II.

Questionnaire for the Analysis of Textbooks in Elementary Mathematics

A. **General information**

1) Title of the book ____________________

2) Class for which it is meant ____________________

3)

	Author's (s') name (s)	Author's (s') qualifications	Publisher's name and address
1.			
ii.			
iii.			
iv.			
v.			

4) (a) Number of pages ______ (b) size of the page (in cms) ______________ (c) price ________

5) Quality of paper

a) White paper which is not likely to wear out easily.

b) White paper which is likely to wear out easily.

c) Yellowish paper which is not likely to wear out easily.

d) Yellowish paper which is likely to wear out easily.

e) Any other, please mention.

____

____

6) Have you come across any printing errors? Yes/No

7) Please give an approximate number of printing errors. ____________

8) Date of publication of the first edition ____________

9) Date of publication of the last edition ____________

10) Number of editions published ____________

11) Language in which the book was originally written.

12) Names of the languages in which the book is translated. ____________

13) Whether approved or recommended by some educational authority. Yes/No

14) If yes please give the name of that authority ____________

B. General organisation of the text-book

1) Does the book relate specifically to a syllabus? Yes/No

2) If yes, to which syllabus does it conform? ____________

2) Are all the topics in the syllabus covered in the text-book? Yes/No

If not, please mention the topics not covered in the text-book? ____________

____

____

3) Are these topics discussed in the book which are not in the syllabus? Yes/No

If yes, please mention these topics. ____________

____

____

4) Are you satisfied with the sequence of the topics given in the book? Yes/No

If not, what sequences would you suggest?

Arithmetic ____________

Algebra ____________

Geometry ____________

____

5) Do you have separate books for the different branches (e.g. Arithmetic, Algebra, Geometry Geometry) of the subject? Yes/No

If not, are these branches dealt in separate sections of the same book? Yes/Not

If not, is the approach to the subject (Elementary Mathematics/General Mathematics an integrated one? Yes/Not

C. Subject Matter

1) Please tick mark the following that are included in the present text-book.

a. Description in narrative form.
b. Discussion in question answer form.
c. Illustrative solved examples.
d. Practice exercises.
e. Exercises for revision.
f. Text papers.
g. Question papers of Boards and Universities.
h. Answers to the sums in exercises.
i. Answers to the sums in question papers.
j. Diagnostic tests.

2) Does the book contain solved examples? Yes/No
If yes, do these clarify the concepts? Yes/No

3) Can a bright student study the subject on his own? Yes/No

4) Do the sums in Exercises provide for individual differences in abilities?
   a. Yes
   b. To some extent
   c. No

5) Does the book contain exercises for revision? Yes/No

6) If so, at what place are these exercises for revision given in the book?
   a. At the end of each chapter.
   b. At the end of each topic.
   c. After all the topics are covered.
   d. Any other, please specify ____________

7) Does the book contain any question papers (question papers of Boards or Universities only)? Yes/No

8) Does the book contain any test papers? Yes/No

9) If so, at what place are these test papers given in the book?

a. At the end of each chapter.

b. At the end of each topic.

c. After all the topics are covered.

d. Any other, please specify. ____________

10) Are answers to all the exercises given? Yes/No

11) Does the book contain problems from day to day real life situations?

a. Yes, Quite a number of them.

b. Yes, a few.

c. No.

12) Have you found any absurdity regarding problems? Please illustrate.

13. Have you come across a large number of errors in exercises? (Please mention about the errors in respect of the subject matter only). Yes/Not

Give an approximate number of errors you have come across. ____________

14) Are the sub-topics (within a topic) developed in a sequential order? Yes/No

15) Are the sums in 'Exercises' graded from simple to complex? Yes/No

16) Are there suggestions given for experimental work? Yes/No

17) Are there any unnecessary lengthy calculations required for solving the sums?

a. Yes, for many sums

b. Yes, for a few sums

c. No.

D. Style of writing

1) Is the language used within the comprehension level of an average student?

a. Yes

b. Yes, barring a few exceptions

c. No

2) What are the methods used for explaining the concept?

a. Discussion-posing a question and then answering

b. Description-direct narration

c. Solved examples by giving practical examples

d. Sums

e. Any other, please mention..

(Check one or more alternatives as applicable in your case)

3) Are the new terms in a topic defined in a clear and exact manner? Yes/No

4) Are the concepts in a topic explained in a clear and definite manner? Yes/No

5) Are the principles involved in a topic discussed in all manipulative forms? Yes/No

D. Pictorial or graphic illustrations

1) Are the pictorial and graphic illustrations adequate?

a. More than required

b, Adequate

c. Inadequate

2) Are the pictorial and graphic illustrations accurate? Yes/Not

3) How do the pictorial and graphic illustrations contribute to the understanding of the subject?

F. **Objectives**

1) Are the objectives of writing the book stated in the preface? Yes/No

2) Does the treatment of the subject in the book has the achievement of the objectives stated in the preface?

a. Yes

b. To some extent

c. No

3) Are the objectives specified in the syllabus achieve in the treatment of the subject in the book? Yes/No

4) Does the development of topics in the book help in achieving the objectives of teaching of Mathematics.

a. Yes

b. To some extent

c. No

G. **Miscellaneous**

1) Are the textbooks of the same author (s) used in different grades of your school? Yes/No

In what grades are these books used?
Pl. mention

____

____

____

If so, please state how the continuity of the topics covered is maintained from grade to grade in all the books.

____

____

____

2) Which of the following things would you like to include in the present text-book?

   a. Practical problems from day to day life situations.

   b. Mathematical tables

   c. Topic-wise tests

   d. Term test papers

   e. Chaper wise summary giving terms and principles involved

   f. Concept-wise practice items

   g. More sums for drilling

   h. Any others please mention.

____

____

3) Which units of measurement are used in the discussion and the sums?

   a. British

   b. Metric

   c. Both

4) Please give your considered opinion regarding the book in a few paragraphs.

APPENDIX (II)

Name of the Student ____________________

Name and Address of the School ____________________

____

Class ____________ Section ________ Date ________

Do you reside in the Hostel? ____________________

____

Instructions to Students

In this booklet some questions have been addressed to you to obtain information about the study of Elementary Mathematics. This information is to be used in a research programme taken up for the whole country. You are, therefore, requested to give correct and accurate information under each question. The success of this research and its use in future for the benefit of the students like you will depend on the corrections and accuracy with which you answer these questions. So, take enough time to answer every question and give the exact answer.

Please answer each and every question given in the booklet without omitting any of them.

Most of the questions given in this booklet are accompanied by alternative answers from which you are to select the alternative that applies to you.

Wherever such alternative answers are given to a question, you are to select one and only one answer that is applicable to you. Please indicate this answer by putting a cross (x) in the box (   ) provided.

For example, answer the following item.

In which class are you studying at present?

A. 8th class

B. 9th class

C. 10th class

D. 11th class

E. None of the above.

You must have put the cross in one box only to inficate your answer. In the same manner you have to indicate only one answer for each question where alternatives are given.

1. About how much time do you spend per week at home to complete your home-work in Elementary Mathematics only? This should include only that time that you devote to the work assigned to you by the teacher an home-work.

   A. Six hours or more

   B. Four to five hours

   C. Two to three hours

   D. One hour or less.

2. When the home-work is not to be shown the next day, do you generally finish it the day it is assigned to you or on the day or the previous day when it has to be shown to the teacher?

   A. The same day when it is assigned

   B. On the day it is to be shown to the teacher.

   C. On a day previous to the day when it is to be shown to the teacher.

   D. None of the above.

3. When do you generally do your home-work?

   A. Just after returning from school

   B. Just before evening meals

   C. After evening meals

   D. In the morning

   E. No fixed time.

4. In addition to the home-work, do you devote any time to the studying of Elementary Mathematics at home apart from your doing so near the examination?

   A. Yes.

   B. No.

   If "Yes", indicate below about how many hours per week do you devote to such study excluding the time for home-work.

________________ hours per week.

If the above answer is "yes", what kind of work do you generally do while studying Elementary Mathematics at home? Write your answer in the space provided.

5. Outside school hours do you study in a group along with other students of your class?

A. Yes.

B. No.

If "yes" indicate the answer applicable to you out of the following alternatives.

A. The whole year.

B. Only at the time of different examinations.

C. Only at the time of annual examination.

If you study in a group, how do you select your partners?

6. Is there any one at your home (not a tutor) who can help you in the study of Elementary Mathematics?

A. Yes.

B. No.

If "yes", indicate below how many persons are there in your home who can help you

No. of persons ____________.

If "yes", do you get help from him/her/them.

A. Yes, regularly

B. Yes, sometimes

C. No.

If you get any help from any one at your home, in what way do you get it?

7. Do you get any tution in Elementary Mathematics from a tutor?

A. Yes.

B. No.

8. Did you get any tution in elementary Mathematics last year?

A. Yes.

B. No.

9. Do you attend a coaching class or a tution class?

   A. Yes.

   B. No.

10. Did you attend a coaching class or a tution class last year?

   A. Yes.

   B. No.

11. You must have solved the sums from your Arithmetic textbook. Indicate the answer applicable to you in this respect out of the following.

   A. I have solved all the examples.

   B. I have solved a majority of the examples.

   C. I have solved only a few examples.

   D. I have not solved any examples other than those that were done in the class.

12. What kind of sums have you omitted in Arithmetic so far.

13. You must have solved the sums from your Algebra textbook. Indicate the answer applicable to you in this respect out of the following.

   A. I have solved all the examples.

   B. I have solved a majority of the examples.

   C. I have solved only a few examples.

   D. I have not solved any examples other than those that were done in the class.

14. What kind of sums have you omitted in Algebra so far?

15. You must have studied theorems in Geometry. Indicate the answer that is applicable to you out of the following in connection with theorems.

   A. I have understood practically all the theorems.

   B. I have understood some of them but remember practically all of them.

   C. I have not understood most of the theorems but remember some of them.

   D. I neither have understood nor remember any of the theorems.

16. You must have solved "riders" in Geometry based on different theorems. In connection with "riders" indicate the answer that is applicable to you out of the following.

    A. I have done practically all the riders from my textbook.

    B. I have done only some selected riders from my textbook.

    C. I have done only those riders which were solved in the class.

17. In addition to theorems and their riders, you must have studied "Constructions" in Geometry. Which one of the following answers is applicable to you in connection with "constructions"?

    A. I have done practically all the constructions given in my text-book.

    B. I have done some selected constructions from my textbook.

    C. I have done only those constructions which were done in the class.

18. Besides exercises, there are a few solved examples given in all the chapters in your textbooks. Have you studied these examples?

    A. Yes, practically all examples.

    B. Yes, some of the examples.

    C. No.

    If "yes", for what purpose did you study these examples?

19. In addition to the solved examples and exercises, there is some explanation given in every chapter for the new topic. Do you read it?

    A. Yes, from practically every chapter.

    B. Yes, in case of few chapter.

    C. No.

20. In addition to your text-book, do you use any other books (excluding the guide books)?

    A. Yes.

    B. No.

21. Do you use any guide books?

    A. Yes.

    B. No.

    If "yes", state below what kind of guide-books you use and whether you use guide-books for all the three subjects viz. Arithmetic, Algebra and Geometry.

22. Have you used question papers of the past examinations in Elementary Mathematics?

    A. Yes.

    B. No.

    If "yes", have you used solved question papers?

    A. Yes.

    B. No.

23. Mention below the way in which you prepared yourself in Elementary Mathematics for the last annual examination.

24. State the purpose for which you study the subject of Elementary Mathematics.

APPENDIX III

Points to be observed in a Mathematics Class

1. Linking the present lesson with the previous one (s)

2. Explanation of the new concepts, principles, relationshps and skills.

3. Ensuring learning of (2).

4. Selection of a problem (or an exercise).

    a) Source, e.g. the textbook, personel note-book, etc.

    b) Appropriateness, e.g. level quality, reality.

5. Presentation of the problem.

6. Analysis of the problem.

7. Ensuring students' understanding of the problem.

8. Solution of the problem.

9. Drilling typical difficulties of the problem.

10. Practice on similar problem.

11. Class work.

    a) Helping students individually

        i) removal of their difficulties.

        ii) in their progress at their own rate.

    b) Helping them in small groups.

    c) Teaching the whole class.

12) a) How does he give home assignments?

    Does he give regular assignment sheets?

    b) Checking of home assignments.

13. Use of motivational devices.

14. Evaluation of pupil achievement during the period.

15. Use of the blackboard.

16. Use of mathematical links and symbels.

17. Use of aids, if needed.

18. Use of textbooks.

19. Use of collateral text-books.

(i) Preportion of teaching load of Elementary Mathematics and Advanced Mathematics (Separately to the teaching load in other subjects.

Name of the teacher ....

Qualifications of the teacher ....

(a) General Education:

(b) Professional Edution

(c) Experience of teaching Mathematics (in years)

- i) Primary classes
- ii) Middle classes
- iii) High & Higher Secondary classes.
- iv) College classes
- v) Training College classes.

Text-books

(a) Who prescribes Text-books ?

(b) Use of text-books in the class

- i) For solving problems
- ii) For reading solved examples (in the class)
- iii) For reading descriptions.

Whether any other material (Books, Question papers etc.) used for teaching ?

Home-work

(a) Whether assigned after every period.

(b) Source

(c) Whether same work given to all students.

(d) Whether checked the home-work in the class

(e) Quality of checking

i) Corrections with instructions

ii) Corrections only

iii) Marking mistakes only

iv) Remarks.

(f) Whether checked through group leaders.

Objectives of teaching Elementary Mathematics.

How are these objectives achieved in the classroom teaching situations?

Revision.

Evaluation of student's achievement during the period.

Examination Results and its use.

Given a free choice, would you like to teach? Elementary Mathematics ?

Any suggestions to make.

APPENDIX III

Points for teachers interview

Identifying data

State ....

Town............................

School..........................

Class & Section ....

General data

Date.....................Day..................

Subject & Topic...............................

Medium of Instruction ....

No. of Students: (a) Total................

(b) Present ....

Time of the day ....

Time-Table: (a) Total No. of periods in a week

....

(b) No. of periods for Elementary Mathematics in a week........

(c) Duration of one period.......

(d) Total time for Elementary Mathematics per week.........

(e) Who frames the time-table ?

....

(f) Distribution of periods in a class for a week ....

....

(g) Allocation of work over sections and over classes; ....

....

(h) Whether teaching any other subject?

APPENDIX III

Purposes of students' Group Interview

To know:

1. The present position of teaching of Elementary Mathematics in Higher Secondary Schools.
2. The position w.r.t. availability of individual help in the school
   a) inside class-room
   b) outside class-room

in small a) within the class
groups b) outside the class.

3. Regularity of checking of home-work assignments.
4. Work lead of home-work.
5. Principal's checking of home-work note-books.
6. Checking of home-work with the help of group leaders.
7. Use of text-books.
   a) Exercises
   b) Other portions.
8. Revision.

Purposes of Teacher's Interview

1. To obtain certain physical information.
2. General techniques of teaching employed by him.
3. Home-work - procedure for checking.
4. Use of text-book
   Other material
   reference.
5. Planning of teaching.
6. Examination - use of their results.
7. Medium of instruction.
8. Teaching load and time allocation.
9. Qualification - general - professional.
10. Clarity of purpose of teaching mathematics.

APPENDIX III

Points for study of note-books

A. **Class note-books**

1. Systematic work done by a majority of the students.
2. Students copy whatever in said by the teacher.
3. Class-work shows no student interest in the subject.

B. **Home-work note-books.**

1. Regularity of assignments. by the teacher.
2. Regularity of work done by the students.
3. Tables of contents in the note-books
4. Regularity of checking by the teacher.
5. Systematic work done by the students.
6. Quality of the checking done.
   - a) Corrections with suggestions
   - b) Corrections only
   - c) Marking the errors
   - d) Just signing
   - e) Remarks.

7) Appropriateness of assignments.
   - a) Level
   - b) Quality
   - c) Based on real situation.

8) Assessment of work noted on the note-books.
   - a) number of times
   - b) any remarks

C. **Examination** Answer scripts.

APPENDIX III

Name of the School ....

Date ....Place..................

Examination Results

Year	Number of Students					
	On roll	Appeared	Passed	Who took Elem.Maths	Who appeared with Elem.Maths	Passed in Elem.Maths
1964						

Total number of students in

IX Class............

X Class............

XI Class ....

Total number of Students offering Elementary Mathematics.

IX Class............

X Class............

XI Class............

APPENDIX IV.

NATIONAL GOALS AND THEIR IMPLICATIONS FOR MATHEMATICS EDUCATION

New India's image of her future is tied up with her Advance in Science and Teachnology This, in turn, should be reflected in:

a) greater use of science in the society's development

b) India's increased contribution to the stock of human knowledge

c) greater utilization of the benefits of science in citizen's everyday life.

A. Mathematics helps in acquiring knowledge and understanding of:

1. the basic facts and principles of modern science, physical and natural, at a sufficiently deep level
2. the broad features of the history of science
3. the significant discoveries and inventions in science and technology and their influence on life
4. The methods of scientific studies
5. the inter-relatedness of the different branches of science, and of science, mathematics and technology
6. the nature of the materials, tools and processes used in technology.

B. Mathematics helps in the development of the attitudes which help in realizing that:

1. the all-pervading nature of the influence of science on almost all aspects of human life is growing
2. no nation can prosper in the world of today without scientific and technological development

3. scientific and technological knowledge does not recognise any boundaries and is the common property of one and all
4. the principle aim of science is to discover and interpret the unity and system in nature
5. technology aims at maximum of productions through optimum exploitation of natural resources
6. working with hands provides insights into scientific and technological processes
7. a technological society expects every individual to work hard
8. the need for developing a scientific attitude to life and its problems is growing, whose chief characteristics are open-mindedness, demand for more and more evidence before generalising.

Mathematics helps in the development of skills which require compentence to be able to:

1. read and appreciate simple scientific literature
2. approach all types of problems with an open mind and tackle them with the orderly method of science
3. understand the working of and handle ordinary mechanical appliances with skill and intelligence.

The nation's Economic Development is the 'sine qua non' for a stable and prosperous demoncracy. Such development is reflected in:

a) the eradication of poverty and the attainment of higher standards of living

b) the maximisation of production

c) the full use of manpower and resources

d) the better flow of distributive services

e) the strengthening of preparedness for defence.

A. Mathematics helps in a better understanding of:

1. the principle economic problems that face India, e.g., poverty, insufficiency of food, inadequate exploitation of resources, unemployment, etc.
2. the ways to solve these problems, e.g., improved agricultural practices, rapid industrialization, spread of education, co-operative movement, planned economy and balanced development
3. the resources of the country, human and natural
4. India's Five Year Plans, their purposes, targets and achievements
5. the basic principles of Economics, and its terms
6. the principles of Business and Industrial organisation.

B. Mathematics helps in the development of the following attitudes:

1. of devoted and continuous effort in every work
2. of avoiding ordinary wastes and of having wise consumption
3. of sharing things, developments, etc.
4. of being free from superstitions, liberal and open-minded
5. of taking economic development as an essential for defence preparedness
6. of hard work.

C. Mathematics helps in developing the following skills:

1. To be able to work effectively and productively in the profession or vocation one chooses later in life.
2. To be able to utilise leisure time in a wise manner.
3. To be able to read and understand reports and studies about economic development of the community.
4. To be able to perform efficiently the ordinary activities involving money transactions.

India desires the Promotion of a Socialistic Pattern of Society

The nation desires:

a) a more equaitable distribution of wealth and income

b) increased State-ownership and State-participation in the means of production.

c) the growth of an effective Welfare State

d) the development of a strong-co-operative sector.

A. Mathematics helps in a better understanding of:

1. Essential characteristics of a Welfare State
2. The specific trends and developments that are leading the country towards the achievement of these goals.
3. Meaning of such terms as mixed economy, public sector, private sector, co-operative sector, etc.
4. The Cooperative Movement and its development in India.

B. Mathematics helps in developing the following attitudes:

1. Favourable attitude towards economic and social justice.
2. An attitude of being responsible for the national enterprises and property.
3. An attitude of sharing with others.

C. Mathematics helps in developing the following skills:

1. To be able to establish, run and develop a school co-operative store.
2. Exhibit in ones actions that one believes in social and economic justice.
3. Initiate social action for public Welfare.

India desires Higher Standards of Health among her people

She expects her citizens:

a) to possess knowledge of basic principles of health,

b) to develop good health practices,

c) to place high value upon personal and social hygiene,

d) to help in the prevention, and ultimate eradication of disease.

A. Mathematics helps in a better understanding of:

1. Important principles of hygiene and balanced diet.
2. Rest and recreation and its balance with work.
3. Cleanliness and sanitation and ensuring problems with their solutions.

B. Mathematics helps in developing the following attitudes:

1. An attitude of being clean and of helping other to be so.
2. An attitude of taking a balanced diet in preference to a diet of favourite articles.
3. A highly unfavourable attitude towards adulteration.
4. An attitude of cooperation with others to keep the locality clean and in good sanitary conditions.

C. Mathematics helps in developing the skills:

1. To observe complete cleanliness in all aspects of life.
2. To participate regularly in games and sports and take rest at proper intervals.
3. To have healthy practices regarding food, work, rest and recreation.
4. To spend leisure time wisely to the best personal and social gains.

The nations dynamism rests upon her capacity for a Cultural and Educational Resource India wishes to make such a resurgence possible, for then her citizens would:

a) take justifiable pride in their rich cultural heritage,
b) develop art in all forms to ever increasing heights,
c) cultivate taste and appreciation of truth and beauty in every aspect of life
d) pursue excellence in every kind of endeavour.

A. Mathematics helps in a better understanding of:

1. Broad details of the cultural heritage of India in all its aspects.
2. The important principles of some major forms of Art and the direction of their growth, especially in India.
3. The contribution of Indians to different branches of knowledge thorough the ages.

B. Mathematics helps in developing following attitudes:

1. A feeling of pride in the rich cultural heritage of India.
2. An attitude of hope and confidence in its future greatness through multi-varied development.
3. An attitude of taking academic excellence of the individual as not only a personal distinction but also as a contribution to the country's total achievement.
4. An attitude of pursuing knowledge for its own sake during leisure time.
5. An attitude of pursuing excellence in every walk of life.

C. Mathematics helps in developing the skills:

1. To study critically and appreciate great works.
2. To pursue knowledge for its own sake.
3. To recognise excellence wherever found.
4. To execute the work to the best of one's capacities.

India desires the Development of a Vital Democracy through:

a) the full and free development of every individual,

b) the growth in her people of an abiding faith in democratic principles and processes,

c) the development of an enlightened and responsible citizenry,

d) the encouragement of leadership at all levels.

Role of Mathematics in developing personal Characterstics essential to democratic living:-

A. Understandings

1. Understanding of wider social problems and relationships.
2. Understanding of form and system in nature and also in man made designs.
3. Understanding the usefulness of Tolerance, Cooperativeness, Self-direction and Creativeness.

B. Attitudes

1. An attitude of considering social problems at a human level.
2. Appreciation of natural and artificial designs and this liking the best in beauty.
3. An attitude of working with others and respecting their view-point.
4. An attitude of convincing others regarding one's own ideas and not just pressing for the same.
5. An attitude of doing self-directed study, self-evaluation and creative work.

C. Skills and Abilities

1. To be able to read and understand reports on social problems objectively.
2. To be able to draw designs after models and independently.
3. To work with others in a group, and to know how to get help from the bright and help the weak.
4. To be able to do independent study and tackle problrms on one's own.

APPENDIX V

LIST OF OBJECTIVES OBTAINED FROM 37 SOURCES

Acquisition of basic information in Mathematics

1. To understand the concept of different units and apply them in practical life.
2. To develop number concept.
3. To understand relationship between fractions, ratio and proportion and use them.
4. To develop the ability to understand and appreciate inter-relationship among various branches of Mathematics.
5. To enable the pupil to be familiar with mathematical terms, symbols, formulae, ideas, relationships, procedures, principles, facts, developments etc.
6. To enable to understand the language of Algebra.
7. To develop concept of direction.
8. To understand mathematical symbols and use them.
9. A progressive increase of understanding of the nature of fundamental operations and power to apply them in new situations.
10. To develop the idea of area and volume.
11. Knowledge of Technical vocabulary of the geometric forms that are commonly observed in objects.
12. Understanding of the fundamental geometrical concepts essential to a successful study of demonstrative geometry.
13. Acqaintance or familiarity with geometic forms with which people in general should be acquinted. To teach children to look for and to recognise geometric froms.
14. To understand percentage and its common application.
15. To perform fundamental operations with monomials and polynomials.
16. Familiarity with geometric forms common in nature industry and life. Mensuration of these forms, development of space percept, exercises of spatial imagination.
17. To acquire knowledge and understanding of fundamental terms, ideas, definitions and assumptions.
18. To develop the concept of balance.
19. To translate verbal statements into formulas.
20. To understand the laws of Algebra for positive, negitive and literal numbers.

Acquisition of Computational Skills in Mathematics.

1. To improve speed, accuracy and neatness in Mathematical work.
2. To learn the technique of problem-solving.
3. To apply the knowledge of four fundamental rules in practical life.
4. The development of self-reliance in the handling of numarical problems through the consistent use of checks.
5. To develop the ability to verify results.
6. To develop the power of prediction of correct results on the basis of given data.
7. To test hypothesis.
8. To develop in them skill, precision, brevity and speed in compulations.
9. Solution of inverse problems in Arithmetic and problems relating to geometry, physics and other natural sciences.
10. To develop a sense of proportion with time factor.

To Develop in the Student Skill in the Use of Mathematical Instruments and Drawing Skills

1. To enable the pupils to use mathematical apparatus and instruments skillfully.
2. To develop such skills as use of the scale in preparing charts & plans, handling and using geometrical instruments, constructing simple models etc.
3. To transform mathematical configuration at higher levels.
4. Selection of appropriate instruments for measurement.
5. To register the measurement in correct units.
6. Ability to estimate geometrical magnitudes.
7. To develop the sense of sysmetry.
8. To recognises the degree of accuracy required in a measurement.
9. To detect errors, if any, in the instruments.
10. To read the scale or measurement accurately.

Development of Certain Personal Qualities (like attitudes, values, reasoning etc.)

1. To learn the technique of problem solving.
2. To develop functional thinking.
3. To work in a logical and systemic order.
4. To develop desirable attitudes and interests.

5. To develop deductive reasoning.

6. To develop self-confidence.

7. To enable the pupil to develop personal qualities e.g. honesty, neatness, truthfullness, tidiness etc.

8. To develop mathematical skills, understanding and attitudes necessary to solve the quantitative problems faced by them in their immediate and anticipated neighbourhood.

9. To develop mathematical perspective.

10. To discover and formulate new geometric facts and relationships.

To Develop an Ability to Draw and Interpret Graphs and Plans

1. To enable the pupil to read graphs and interpret data by graphs.

2. To develop the ability to draw plans and interpret the given plan.

3. To enable the pupil to identify the scales used in the graph.

4. To enable him to read the graph and make simple interpolation and extrapolation.

5. To choose the kind of graph suitable for its representation.

6. To draw infrences about any deviation from the general trend.

7. To recognise the situations in which a graphical approach of representation serves a useful purpose.

8. To solve quadratic and simple equations graphically.

9. To represent the formulas graphically.

Development of Logical, Critical & Relational Thinking

1. To develop the power of generalisation from concrete data.

2. To develop in pupils certain habits and attitudes e.g. logical and critical thinking, objective reasoning, spirit of enquiry, accuracy and pracision of expression, orignality, concentration and intutive judgements.

3. Development of ability to think clearlyin terms of ideas and concepts.

4. To enable the pupil to develop the habit of rational and analytical thinking.

5. To enable them to understand and appreciate logical, critical and independent thinking in others.

6. To enable them to recognise the adequacy or indequacy of given data in relation to the problem.

Appreciation in Mathematics

1. Appreciation of power of mathematics.
2. Acquisition of appreciation of beauty of geometrical forms.
3. To create an Educated public, able to understand and appreciate the place of Mathematics & Science in present technological age.
4. Appreciation of the usefulness of mathematics in other subjects and in everyday life.
5. Appreciation of the power of computations.
6. Appreciation of the tool of Algebra in solving problrms.
7. Appreciation of the value of logical reasoning.
8. Appreciation of the value of algebraic notations and symbols.

Development of an Ability to Apply Mathematical Principles, properties etc. in Solving New Situations and Problems

1. To develop abilities and skills in handling life situations involving mathematical concepts.
2. To apply knowledge in solving mathematical problems in other subjects.
3. To use mathematical relations in estimating costs, distances and other quantities.
4. To recognises approximate limitation in the data relating a problem.
5. To use arithmatic in solving business-problems.
6. To use various formulae involving quantitative relationship.

Ability to Locate Valid and Reliable Information in Mathematics.

1. To recognise the implication of an information in an observation.
2. To select relevant observations for purpose of drawing certain inferences.
3. To locate mistakes in the case of invalid inferences.
4. To recognise that the validity of inferences also depends upon the truth of assumptions.
5. To develop skill in collecting information from original sources.

Development of Interest in Mathematics and to Form a Basis for Higher Mathematical Studies

1. To create interest in mathematics and form an attitude for mathematical work.
2. To develop mathematical perspective.

3. To enable the pupil to be relaxed and entertained by mathematical amusements, pastimes and puzzles.

4. To develop methematical interest through recreational activities and problems.

5. To prepare a suitable background for further serious mathematical studies.

6. To enable the pupil to form a basis or a foundation for understanding science and technology.

To Develop an Ability to Study, Memorise and Apply Mathematical Tables.

1. To memorise mathematical tables and make use of them himself.

2. To develop skill in the use of mathematical tables and ready reckoners.

3. To locate the correct reading in a given table.

4. To recognise items of informations included in a particular table.

To Develop Skill in the Use of Mathematical Language

1. To develop skill in the use of mathematical language in understanding the world about them.

2. To enable pupil to understand, express and interpret symbolic representation precisely, exactly and systematically.

3. To understand mathematical symbols and use them.

4. Knowledge of technical vocabulary of the geometric forms that are commonly observed in objects.

APPENDIX VI

Topics	Objectives 1	2	3	4	5	6	7	8	9	10
1. Rational Numbers	x	x		x	x			x		x
2. Real Numbers	x	x		x	x			x		x
3. Algebraic expression	x	x		x	x			x	x	x
4. Products & Factors	x	x			x	x		x		x
5. Exponents & Powers		x			x	x		x	x	x
6. Roots & radicals	x	x			x	x		x		x
7. Logarithms	x	x			x			x		x
8. Permutation & Combination	x			x	x	x	x	x		x
9. Binomial expansion		x			x	x		x	x	x
10. Progressions	x	x		x	x	x		x	x	x
11. Compound interest	x	x			x	x		x	x	x
12. Instalment buying	x	x			x			x	x	
13. Budgeting	x	x			x		x	x	x	
14. Banking, Foreign Exchange & Credit bills	x	x			x	x	x	x	x	
15. Discounts	x	x			x	x		x	x	x
16. Stocks & Shares	x	x			x	x		x	x	x
17. Insurance	x	x			x		x	x	x	
18. Taxes	x	x			x		x	x	x	
19. Cooperative Societies	x	x			x		x	x	x	
20. Points, Lines & Planes	x		x		x	x			x	x
21. Angles & Triangles	x		x		x	x			x	x
22. Congruences	x		x	x	x	x			x	x
23. Geometric inequalities	x			x	x	x		x	x	x
24. Perpendicular lines & Planes in space	x		x			x			x	x
25. Parallel lines in a plane	x		x			x			x	x
26. Parallel lines & planes						x			x	x
27. Polygonal regions & their areas	x		x		x	x		x	x	x

28. Similarity	x		x	x	x	x			x	x
29. Plane coordinate Geometry	x		x	x	x	x		x	x	x
30. Circles & Sphere	x		x		x	x		x	x	x
31. Areas of Circles & Sectors	x	x	x			x		x	x	x
32. Solids & their volumes	x		x			x		x	x	x
33. Constructions			x						x	x
34. Equations & inequalities (first degree)	x	x	x	x	x	x	x	x	x	x
35. Quadratic equations & quadratic inequalities	x	x	x	x	x	x	x	x	x	x
36. Relations, Functions & Graphs	x		x	x	x	x	x	x	x	x
37. Trigonometric ratios	x	x	x			x		x		x
38. Ratio & proportion				x	x	x		x	x	x
39. Statistics (Definition, Basic concepts, Measures of Central tendency, Measures of dispersion)	x	x	x	x	x		x	x		x
40. Probability	x	x				x	x	x	x	x

APPENDIX VII

List of Understandings, Skills and Attitudes

Understandings

1. Mathematics is a collection of mathematical system. Some of these systems, while logically independent of each other, are nevertheless quite intimately related.
2. A methematical system contains
   a) undefined elements
   b) the postulates - the initial statements about elements, which are agreed to rather than proved by reasoning
   c) a method of reasoning
   d) established conclusions or theorems.
3. Mathematical concepts are generalisations or abstractions suggested by elements of familiar objects or experiences.
4. There is a logical order in mathematics which must be preserved.
5. Mathematics is as much a method as it is a body of content.
6. Discovery in mathematics, calls for creative ability and imagination which must go far beyond the limits of visualisation.
7. Mathematics uses all types of reasoning to suggest possible conclusions but no conclusion is accepted until it has been proved deductively.
8. Mathematics as a method can be applied to any field. It is being adopted more and more by the physical science, the social sciences and philosophy.
9. All sciences are tending more and more towards mathematical form.

10. The historical development of mathematics forms a fascinating story of man's effort to acquire and develop useful ideas about number and space.
11. Mathematics is a language of quantity, size and order. It is also a language for exploring logical relations.
12. Mathematics is a universal language.
13. A quantitative idea expressed symbolically can pass from one individual to another without loss of meaning.

Skills

1. Skill in computing with numbers with speed and accuracy.
2. Ability to perform calculations mentally.
3. Ability to estimate and check results.
4. Ability to use and interpret graphs, simple statistics and tabular presentations of quantitative data.
5. Ability to make sound judgements with regard to practical, quantitative problems.
6. Ability to use mathematical tools.
7. Ability to think critically, to draw inferences and to generalise.
8. Ability to identify a problem, define it clearly and to plan a procedure for its solution.
9. Ability to represent designs and spatial relations by drawings.

Attitudes

1. To work independently.
2. To base judgements upon objectively verifiable data.
3. To solve problems by numerical methods.
4. To appreciate the contribution of mathematics to personal lives as well as to society as a whole.
5. To enjoy statistical comparisons, economic estimates and mathematical formulations.
6. To appreciate geometric form as it occurs in nature, art, industry and architecture.

APPENDIX.VIII.

Strands in Elementary Mathematics Curriculum

The basic strands in the elementary curriculum are numbers and operations, geometry, measurement and applications

Strand I

NUMBERS AND OPERATIONS

The instructions in the area of numbers and operations has three basic objectives, namely:

A fundamental understanding of the system of rational numbers, with some preparation and resultant readiness for the notion of real numbers

Computational skill which encompasses (a) facility with the number facts and (b) understanding of the principles of operations and of the positional system, with particular insight into computational algorithms

Ability to apply knowledge of numbers in relatively simple but increasingly complex situations.

Content

1. Understanding the rational number system
2. Unifying principles for the rational number system
    a) Early developmental stages, one-to-one correspondence.
    b) Place value
    c) Number and numeral
    d) Order: The number line
    e) Operations
    f) Closure

  - g) Commutativity
  - h) Associativity
  - i) Identity elements - zero and one
  - j) Distributivity
  - k) Systems of numeration

3. Factors, multiples, primes
4. Attainment of computational skills
5. Square root.

Strand 2.

GEOMETRY

More attention is given to early and progressive development of geometrical concepts in the elementary grades.

The introductory stage consists of becoming acquainted informally with some standard geometric shapes and forms. These would include such plane shapes as triangles, rectangles, squares, circles, and ellipses; and such solid forms as sphers, cubes, rectangular prisms (boxes), cones, and cylinders. Familiarity with these shapes and forms is gained through pictures, models, and examples from everyday life. Some properties of these geometric figures may be informally developed so that pupils can identify the figures.

Following this recognition and identification level, the analytical stage begins. Some basic geometric concepts concerning points, lines, and planes are necessary for analyzing properties of geometric figures. A few of these concepts are presented in an intuitive setting.

Content

Point

Line

Plane

Congruence.

Polygon

Angle

Parallelism

Circle

Basic geometric constructions using straightedge, compass, protractor, and other instruments

Scale and perspective drawing using ruler and protracter.

Strand 3

MEASUREMENT

Measurement is a key process in the application of mathematics since it is a connecting link between mathematics and our physical and social environment.

Measurement is a process whereby numbers are assigned to certain quantitative facets of our environment-namely, those facets which are concerned with magnitude rather than multiplicity.

Content

The introductory stage of the study of measurement consists of becoming familliar first with the things to be measured (e.g., line segments, solids, weight, and time), and then with such common units of measurement as the inch, feet, yard, mile, pint, quart, gallon, ounce, pound, minute, hour, day, week, month, and year. Familiarity with these things and units of measure is gained through a variety of experiences in seeing and feeling. Initially, comparisons are at a "greater than" or "less than" level. The refinement and complexity of the various units of measure determine the grade in which each one is introduced in the school programme.

The analytical stage, which follows the recognition and identification stage, can begin with the development of some fundemental concepts. Length is an essential property associated with a line segment. Measure associates a number with the length of a line segment.

An understanding of the approximate nature of measurement is essential.

Measurement of angles, areas, and volumes.

Strand 4.

APPLICATION OF MATHEMATICS

Applications in the learning of mathematics are essential in two important ways. First, it is through applications that the pupil is introduced to many mathematical concepts, and his understanding of these concepts is deepened as he applies them to a variety of situations. Second, interest and motivation increase as the pupil sees widespread significant uses of mathematics.

Strand 5.

FUNCTIONS AND GRAPHS

The function concepts is a powerful idea that permeates most of mathematics, and it has many applications.

The idea of a mathematical function has its beginning in the very basic experience of pairing, common in most programs for the primary grades.

In the early beginnings of arithmetic, the pupil also learns to associate a number with a set of objects and to count by pointing to the objects in sequence and pairing them with the set of ordered number words. He learns that counting is a way of determining what number is to be associated with a certain collection of objects; thus counting numbers may be considered a function of sets.

Possibilities of pairing situations are found in abundance throughout the elementary grades.

The pairing of geometric figures with numbers, which occures in measurement and menusration, involves the function concept.

The introduction of simple formulas in the arithmetic program affords an opportunity for a deeper experience with the function concept.

Graphs and tables are effective ways of presenting functions.

Strand 6.

SETS

The concept of a set is fundamental for communicating ideas in mathematics, just as it is in our everyday language.

Pupil should become familiar with the simple concepts and language of sets. In kindergarten and grades one through eight the approach should be from a linguistic point of view utilizing the role set terminology plays in accurate and unambiguous communication.

Strand 7.

THE MATHEMATICAL SENTENCE

Since language is the primary means for the communication of ideas, a pupil should develop skills in using language to express ideas with clarity and precision. The language of mathematics is particularly suited to this purpose. The pupil's experiences with mathematical sentences should grow naturally out of his experience with arithmetic.

Strand 8.

LOGIC

It should be observed at the beginning of the discussion that we do not suggest a formal study of logic in the elementary school. Rather at this level we are concerned with building a strong background of readiness experiences in logical thinking which will facilitate the pupil's acquisition of patterns of precise mathematical reasoning. This is accomplished by utilizing opportunities in the arithmetic program to delineate logical ideas and concepts.

APPENDIX IX.

Comparison of topics in old Syllabus and Proposed Syllabus

ARITHMETIC

Old Syllabus

1. Simple and compound interest
2. Percentage
3. Profit and loss
4. Vulgar and decimal fractions
5. Areas and volumes
6. Discount
7. Ratio and proportion
8. Square root
9. Average
10. Foreign exchange
11. Banking, insurance, Credit bill.
12. Stocks and shares
13. Approximations
14. Time and work
15. Metric systen
16. Partnership
17. Unitary method
18. Taxes
19. Proportional division
20. Time and distance
21. Factors and prime numbers
22. G.C.M and L.C.M
23. Numerations, notation
24. Four fundamental rules
25. Payment by instalements
26. Graphs
27. Practice
28. Calendar

Proposed Syllabus

Topic excluded

1(Simple interest), 3,4,8, 9, 13, 14, 15, 16, 17, 19, 20, 21, 22, 23, 24, 27 and 28.

Emphasis is laid on the followings:

a) Basic properties of number system.

b) Formal properties of operations.

c) Axiometic exposition.

d) Rules of deduction and more precise definitions.

e) Clearly defined terminology.

f) Precise symbolsim through the language of sets.

The topics in Arithmetic other than excluded topics are discussed under the head 'Percent and Percentage'.

ALGEBRA

Old Syllabus

1. Simple equation with one
2. Simple equation with more than one unknowns and problems.
3. Factors.
4. Formulae and their application
5. Fractions
6. Four fundamental rules
7. H.C.F and L.C.M
8. Simple quadratic equations
9. Ratio and Proportion
10. Graphs
11. Directed numbers
12. Square root
13. Indices and surds
14. Logarithms
15. Progressions
16. Elimination
17. Binomial theorem
18. Involation and evolution

Proposed Syllabus

Topics excluded

11, 16, and 18.

Emphais is laid on basic ideas such as variable, functions, relation, equations and inequalities and the development of an appreciation of the structure of algebra stressing the commutative, distributive and similar other properties and axioms.

Some topics are reorganised. The range of topics, thus obtained, is:

1. Rational numbers
2. Real numbers
3. Algebraic expressions
4. Products and factors
5. Exponents and powers
6. Roots and radicals
7. Logarithms
8. Permitation and combination
9. Binomial expansion
10. Progressions
11. Equations and inequalities
12. Quadratic equations and quadratic inqualities.
13. Relations, functions and graphs.
14. Ratio and proportion.

GEOMETRY

Old Syllabus

a) Tteoretical Geometry: Theorems as per "A school Geometry by H.S. Hall and F.H. Stevens, Mac millan & Co."

b) Practical Geometry: Problems as per "A School Geometry by H.S. Hall and F.H. Stevens, Mac millan & Co."

Proposed Syllabus

Emphasis is puton

1. Axiometric structure and the nature of proof
2. Basic ideas, such as symmetry: Similarity; congruence; inductive geometry and deductive proof; meaning of 'if and only if' and 'if then'; converse of a statement definition and postulate; in keeping with the modern spirit of the subject.
3. Analytical methods
4. Geometric inequalities
5. Perpendicular lines and planes in space
7. Parallel lines and planes
8. Polygonal regions and their areas
9. Similarity
10. Plane coordinate geometry
11. Circles and spheres
12. Areas of circles and sectors
13. Solids and their volumes
14. Constructions.

TRIGONOMETRY

Old Syllabus	Proposed Syllabus
1. Sexegesimal measure of an angle 2. Positive and negative angles 3. Angles greater than four right angles. 4. Trigonometric ratios and identities based theorem. 5. Graphical representation of trigonometric ratios. 6. Trigonometric ratios of complementary and supplementary angles. 7. Radian measure of an angle. 8. Conditional identities. 9. Solution of triangles. 10. Easy problems on heights and distances. 11. Graphs of sinx, cosx, tanx, cotx secx, cosecx.	Trigonometry has been related to Algebra and much of the work on identities, solution of triangles, etc has been eliminated. Emphasis is laid on the study of trigonometric and logarithmic functions.

STATISTICS

1. Frequency tables 2. Averages 3. Deviation from the mean 4. Graphical representation 5. Interpretation of graphs.	Statistical notions such as averages mean, median, mode, median, dispersion, etc. and probability have been introduced in consideration of their growing usefulness in life.

APPENDIX X.

'Functional Competencies' as described in the Guidance Report of the Commission on Post-War Plans of the National Council of Teachers of Mathematics and published in the Mathematics Teacher;

1. Computation. Can you add, subtract, multiply, and divide effectively with whole numbers, common fractions, and decimals?

2. Percents. Can you use per cents understandingly and accurately ?

3. Ratio. Do you have a clear understanding of ratio ?

4. Estimating. Before you perform a computation, do you estimate the result for the purpose of checking your answer?

5. Rounding number. Do you know the meaning of significant figures ? Can you round numbers properly ?

6. Tables. Can you find correct values in tables; e.g., interest and income tax?

7. Graphs. Can you read ordinary graphs: bar, line and circle graphs? The graph of a formula ?

8. Statistics. Do you know the main guides that one should follow in collecting and interpreting data; can you use averages (mean, median, mode), can you draw and interpret a graph ?

9. The nature of measurement. Do you know the meaning of a measurement, or a standard unit, or the largest permissible error, of tolerance, and of the statement that "a measurement is an approximation"?

10. Use of measuring devices. Can you use certain measuring devices, such as an ordinary ruler, other rulers (graduated to thirty-seconds, to tenths of an inch, and to millimeters), protractor, graph paper, tape, caliper micrometer, and thermometer?

11. Square root. Can you find the square root of a number by table or by division ?

12. Angles. Can you estimate, read, and construct an angle ?

13. Geometric concepts. Do you have an understanding of point, line, angle, parallel lines, perpendicular lines, triangles (right, scalene, isosceles, and equilateral), parallelogram (including square and rectangle), trapezoid, circle, regular polygon, prism, cylinder, cone, and sphere?

14. The 3-4-5 relation. Can you use the Pythagorean relationship in a right triangle ?

15. Constructions. Can you with ruler and compass construct a circle, a square, and a rectangle, transfer a line segment and an angle, copy a triangle, divide a line segment into more than two equal parts, draw a tangent to a circle, and draw a geometric figure to scale?

16. Drawings. Can you read and interpret reasonable well, maps, floor plans, mechanical drawings, and blueprints ? Can you find the distance between the points on a map?

17. Vectors. Do you understand the meaning of vector, and can you find the resultant of two forces ?

18. Metric system. Do you know how to use the most important metric units (meter, centimeter, millimeter, gram, kilogram)?

19. Conversion. In measuring length, area, volume, weight, time, temperature, angle, and speed, can you shift from one commonly used standard unit to another widely used standard unit; e.g., do you know the relationship between yard and foot, inch and centimeter, etc.?

20. Algebraic symbolism Can you use letters to represent numbers; i.e., do you understand the symbolim of algebra - do you know the meaning of exponent and coefficient ?

21. Formulas. Do you know the meanings of a formula - can you, for example , write an arithmetic rule as a formula, and can you substitute given values in order to find the value for a required unknown ?

22. Signed numbers. Do you understand signed numbers and can you use them?

23. Using the axioms. Do you understand what you are doing when you use the axioms to change the form of a formula or when you find the value of an unknown in a simple equation?

24. Practical formulas. Do you know from memory certain widely used formulas relating to areas, volumes, and interests, and to distance, rate, and time?

25. Similar triangles and proportion. Do you understand the meaning of similar triangles, and do you know how to use the fact that in similar triangles the ratios of corresponding sides are equal? Can you manage a proportion?

26. Trigonometry. Do you know the meaning of tangent, sine, cosine? Can you develop their meanings by means of scale drawings ?

27. First steps in business arithmetic. Are you mathematically conditioned for satisfactory adjustment to a first job in business; e.g., have you a start in understanding the keeping of a simple account, making change, and the arithmetic that illustrates the most common problems of communications and everyday affairs?

28. Stretching the dollar. Do you have a basic for dealing intelligently with the problems of the consumer; e.g., the cost of borrowing money, insurance to secure adequate protection against the numerous hazards of life, the wise management of money, and buying with a given income so as to get good values as regards both quantity and quality?

29. "Proceeding from hypothesis to conclusion". Can you analyse a statement in a newspaper and determine what is assumed and whether the suggested conclusions really follow from the given facts or assumptions"?

-.-.-.-.-.-.-.-

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